Aug. 6, 1935. B. O. TILDEN 2,010,119

FLUSH VALVE

Filed May 19, 1933

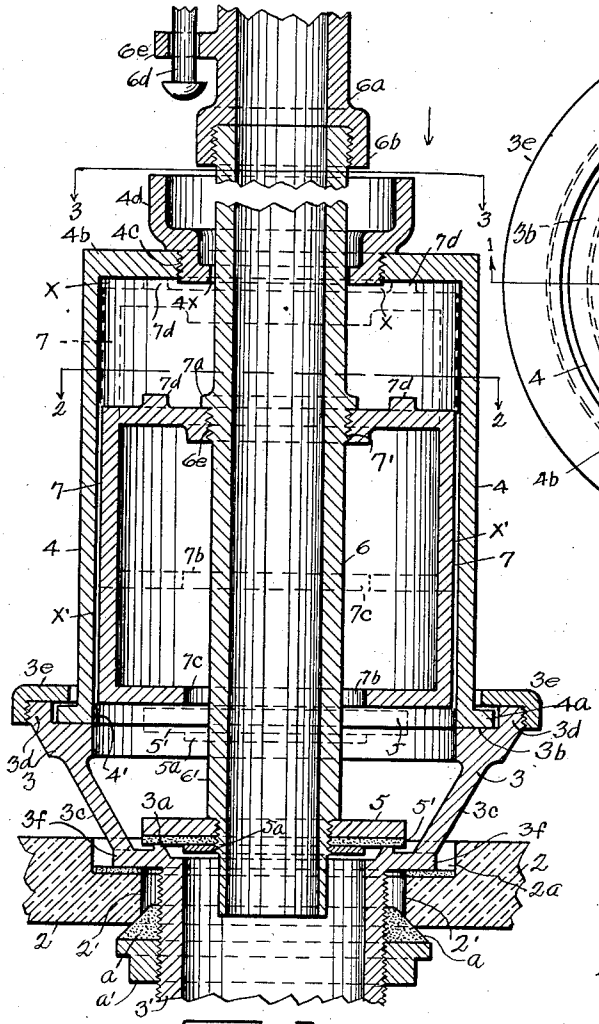

FIG-1

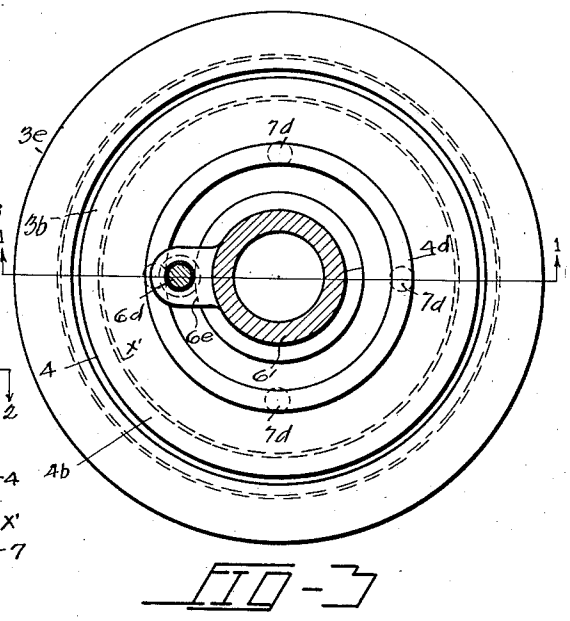

FIG-3

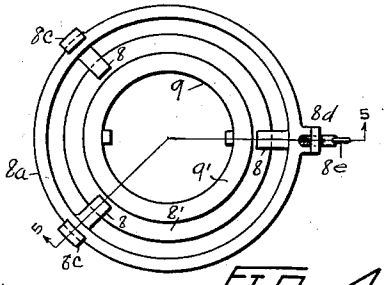

FIG-4

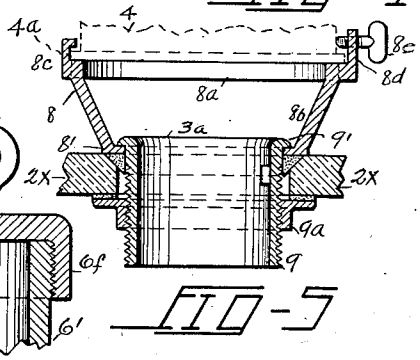

FIG-5

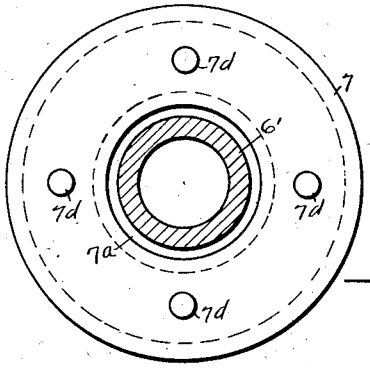

FIG-2

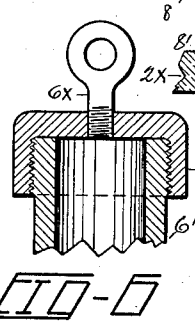

FIG-6

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2,010,119

FLUSH VALVE

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7 Claims. (Cl. 4—58)

This invention relates to improvements in flush tanks for water closets, and has especial relation to the valve mechanism by which the flushing of the closet bowl is controlled.

This invention relates particularly to improvements in the flush valve shown and described in my pending application, Serial No. 654,678.

The primary object of the invention is to simplify the construction of the valve operating mechanism and thereby to lessen the cost, increase its efficiency and render the same less liable to get out of order. A further object is to provide a flushing opening in the bottom of the tank fitted with a floor-level seat engaged by an annular valve that is mounted axially upon a sectional tubular stem which may comprise the usual overflow pipe common to modern flush tanks. A further object is to provide a hollow cylindrical float that is concentrically and rigidly mounted upon the section of the stem that directly supports the valve, the top of the float being closed and its bottom being normally open to admit both air and water; the float being disposed axially and being reciprocable in an upright cylindrical chamber having a closed top and an open bottom; the diameter of the float being slightly less than the inner diameter of the chamber, to provide a thin clear water space therebetween adapted to be flooded with water when the tank is filled; the top of the chamber having an axial opening that loosely receives the tubular valve stem and serves as the sole guide for the said stem, thereby leaving the lower section of the stem as well as the valve free to float horizontally and adjust themselves relatively to the inner wall of the chamber and the valve seat, in order to prevent cramping or sticking of the parts; the top of the float adapted when the valve is lifted to approach near to the closed top of the chamber and to be held in said elevated position by vacuum supplemented by surface tension of the water that surrounds the float, and the said chamber being provided at its top end with a concentric detachable cup-shaped reservoir or depression which is left brim-full of water when the level of the main flushing body falls below the top of said cup, the water confined in said cup having no outlet except the relatively narrow clearance around the valve stem where it passes through the neck of the cup which feeds the water slowly under sufficient friction to insure the steady and timely descent of the valve and related parts, by prolonging the vacuum and preventing the closing of the valve until the tank is substantially empty.

The various features and parts of the invention will be understood from the detailed description which follows, and by reference to the accompanying drawing, in which—

Figure 1 is a central vertical section taken on line 1—1 of Fig. 3. Fig. 2 is a horizontal section taken substantially on line 2—2 of Fig. 1, showing a plan of the top end of the float. Fig. 3 is a top plan view taken in the direction of the arrow in Fig. 1. Fig. 4 is a top plan view of a modified cage and spud connection. Fig. 5 is a vertical cross section taken substantially on line 5—5 of Fig. 4. And Fig. 6 is a broken central vertical section of the top end of the lowermost member of the tubular valve stem of Fig. 1, showing the top end of said member closed by a screw cap to prevent overflow water from entering the tube, in case integral overflow means are provided in a tank.

In the drawing, 2 represents the bottom of a china or like flush tank having the usual central discharge opening 2', in which is removably disposed a cage-like metal valve body 3 including an integral threaded spud portion 3' that extends loosely through said opening and discharges the flushing water into a water closet bowl (not shown). The top of the spud is formed with the usual annular valve seat 3a which preferably lies substantially in the plane of the bottom 2, in order to effect the complete emptying of the tank at each flushing operation. The cage itself comprises a flared upstanding part including a ring 3b supported by inclined legs 3c and surrounded by an upright threaded annular flange 3d to receive a circular nut 3e that loosely confines the valve controlling parts, the nuts 3e being normally spaced from the bottom flange of the chamber by flange 3d. The legs 3c are so spaced as to admit the free flow of the flushing water towards the outlet defined by the valve seat 3a. At the junction of the cage and spud, is formed an annular flange 3f, which seats in a recess 2a of the bottom 2 concentric to the opening 2', and the clear annular space that surrounds the spud is preferably sealed by a packing a, which is usually held in place by a nut a' that rigidly secures the cage and related parts to the bottom 2.

4 represents a cylindrical float chamber having a normally open bottom 4' surrounded by an annular flange 4a that seats by gravity upon the ring 3b within the flange 3d, the chamber 4 being effectively although loosely held in place by the nut 3e, as shown in Figs. 1 and 3. The top end 4b of chamber 4 is preferably closed except for a concentric tapped opening 4c which is

bushed by the threaded neck of a shallow cup 4*d*, preferably of the grease-dispensing type, that plays an important part in the control of the flush valve.

The flush valve proper may comprise a flat annular member 5, which is threaded centrally to receive the threaded lower extremity of a sectional tubular stem 6, the said parts coinciding axially with the seat 3*a*. Ordinarily, the bottom face of the valve is shod with a washer-like sheet of leather or like compressible material 5' that engages the seat 3*a* and may be held in place by a nut 5*a* that engages the protruding end of the stem. From the valve 5, the lowermost section 6' of the stem extends upwardly axially through and beyond the top 4*b* of chamber 4 and through the auxiliary cup 4*d* and is threaded to facilitate coupling thereto, a tubular extension 6*a*, of like caliber, whose lower end is formed with a threaded socket 6*b* for the purpose. The section 6*a* preferably terminates at a point an inch or more above the normal level of the flushing water when the tank is filled. The sections 6'—6*a* of the valve stem are designed, when the valve 5 is seated, to perform the usual functions of the well-known overflow pipes (except overflows that are molded integrally with the tanks), which heretofore have been disposed in various parts of the flush tanks and ordinarily have no direct connection with the flush valves proper. The section 6*a* of the stem may be fitted with a laterally projecting perforated lug 6*c*, to which an ordinary lift-rod, as 6*d*, may be connected, as shown in Fig. 1. The bore of the sectional stem 6 is preferably straight and of such caliber as to surely carry off the surplus water in case the ballcock fails for any reason to close. When the tubular stem 6 functions as the overflow, as shown in Fig. 1, it discharges the surplus water through the valve 5 and thence into the spud 3', as in my pending application. Within the chamber 4, section 6' of the stem is fitted with a concentric hollow drum 7 that performs the function of a float by which the stem and valve may be suspended during the flushing operations, as shown dotted in Fig. 1. The diameter of the drum 7 is slightly less than that of the chamber 4 to provide a thin clear space therebetween adapted to be flooded with water whenever the tank is filled. The top end of the drum 7 is preferably closed except for an axial threaded opening 7' which is engaged and plugged by complementary threads 6*e* that are formed on the medial portion of section 6', and in order that this connection may be suitably reinforced and the parts properly aligned, section 6' is formed adjacent the threads 6*e* with a molded annular shoulder 7*a* that engages the adjacent top of the float. The bottom 7*b* of the float 7 is closed except for a concentric opening 7*c* which is preferably considerably larger than the stem 6 for the purpose of admitting air as well as water that contribute to a certain extent to the buoyancy of the float as well as the timing of the closing of the valve. A particular object of the clear open bottom 4' of chamber 4 is to facilitate the assembling of the float and stem and enable the lower section 6' as well as valve 5 to freely shift or float horizontally within a slight range, to permit self-adjustment of the said parts during the flushing operations and thus obviate danger of cramping or sticking, as may be understood by consulting Fig. 1.

In designing the present valve control mechanism, I have endeavored to effect the standardization of all movable as well as stationary parts such as the float chamber 4, the sectional tubular stem 6 and the float 7, in order that the said mechanism might be readily and economically manufactured. This comprehends providing but one set of patterns, molds and the like, as well as the establishment of fixed areas and capacities of such water spaces as x and x' that separate the tops and sides of the float chamber 4 and float 7, to the end that no adjusting means that demand attention may be required in order to time the descent and closing of the valve. In carrying out these objects, the valve 5, stem 6 and float 7 are arranged to reciprocate as one part, and when raised to start the flushing operations, the top end of the float approaches relatively close to the under face of the top 4*b* of chamber 4 and forms the important narrow horizontal space x, which may be defined as to depth by a series of upstanding teats 7*d* that are preferably integral with the float. The connected spaces x and x' all become flooded with the flushing water during each filling of the tank. By this arrangement, the float 7 is entirely surrounded by water as long as the level of the main flushing body remains above the plane of the top 4*b* of the float chamber. The water content or capacity of the standardized space x in the present case, however, is preferably less than the volume actually required to accurately time the closing of the valve, for reasons that will later appear. The flooding of the spaces x—x' provides a source of surface tension and vacuum-like force in the regions x and x' which supplement the natural buoyancy of the float, so that these combined forces tend during the flushing intervals to retard the gravitation of the valve and related parts to such extent that the closing of the valve approximates in point of time the emptying of the tank, which is the primary object of the invention. The standardizing of the space x having the deficient water content which is liable to be completely drained soon after the level of the main flushing body falls below the plane of said space and thereby prematurely destroy the vacuum upon which the full closing movement of the valve depends, calls for an auxiliary supply of water, to supplement the contents of space x and complete the timely closing of the valve, which in the present case is provided in a novel way by the shallow open top cup 4*d* which is disposed entirely outside of the chamber 4 and is therefore accessible at all times and may be applied and removed at will without disturbing the chamber 4 and related parts. In practice, in the final preparation for manufacturing the cups 4*d*, the latter are tested out and their proper capacities determined upon before they are permanently installed. Thereafter no further adjustment either by plumbers or by the users of the tank will be required. The cup 4*d* has a threaded neck and screws into the axial opening 4*c* of the top 4*b*. The opening in the neck of the cup is preferably larger than the tube 6*a*, so as to provide clear communication between the interior of the cup and the space x, which enables the water content of the cup to slowly drain into the space x in order to prolong the vacuum in said space that retards the descent of the float and valve. At the start of the flushing of the tank, the spaces x—x' contain atmospheric pressure which in the present case is expelled through the cup 4*d* by the flooding of the chamber 4, and thereafter no air can enter

the float chamber to interfere with the operation of the flushing control until said chamber is drained.

At the start of the flushing of the tank, the water wells up inside and outside of the chamber 4, and after having filled the interstices between the chamber and float, continues to rise until its normal level is attained. It is during this latter interval that the cup 4*d* receives its supply of water that later filters through the thin clearance 4*x* and mingles with the diminishing volume of water in space *x* thereby supplementing the latter for prolonging the vacuum and accurately timing the closing of the valve 5.

There is no virtue in the contents of the cup 4*d* as long as the level of the water in the tank is at normal stage, but as this level sinks below the top of the cup, the latter is left brim-full and ordinarily retains substantially the whole of its supply for several seconds after the main body level has fallen below the plane at which the primary supply of water in the space *x* becomes ready to recede. It is at this stage of the flushing that the water in cup 4*d* begins its slow steady feed into the space *x* via the thin clearance 4*x* and delays the emptying of space *x* by prolonging the vacuum until the cup itself is drained. By this means, when the capacity of cup 4*d* is carefully computed, the timing of the seating of the valve 5 may substantially coincide with the complete emptying of the flush tank.

The provision of the opening 7*c* in the bottom of the float 7 lessens its weight and relieves to some extent the cushioning effect of the present float near the end of the flushing intervals, as compared with the bulky airtight float of my pending application which tends to unnecessarily retard the final closing of the valve until after the tank is emptied thereby causing a waste of water. This lightening of the float also lessens the work of the more or less weak vacuum in the region *x*. By providing the relatively large opening 7*c*, the float is constantly charged with air which becomes compressed by the water when the float is submerged and renders the float more or less buoyant throughout the flushing periods.

Figs. 4 and 5 illustrate a modified valve body comprising a cage 8 and a detachable spud 9. The cage consists of a base-ring 8′, that seats upon the tank bottom 2*x*, and an elevated ring 8*a* supported by angular legs 8*b*, the ring 8*a* being formed with integral lugs 8*c*—8*d*, the latter lug being perforated and threaded to receive the single thumb-screw 8*e* that effects the locking of the bottom of the float chamber to the cage. The spud 9 is a substantially plain tube whose top end is formed with an annular flange 9′ that rests by gravity upon the base-ring 8′, and the lower external surface of the spud being threaded to receive a nut 9*a*, by which the two-part body is clamped to the tank bottom.

In Fig. 6 is shown a slightly modified tubular valve stem, wherein the top section 6*a* is removed and then the top end of section 6′ sealed with a cap 6*f*, which is fitted with an eye-bolt 6*x* to facilitate attaching the usual lift-rod (not shown) for opening the valve. The object of this modified arrangement is to enable the section 6′ to perform the functions of the valve stem without requiring any change except as shown, in case the valve controlling mechanism is applied to vitrified flush tanks wherein the overflow is an integral part of the tank, as described.

Having thus described my invention, what I claim, is—

1. In a flush valve operating mechanism the combination with the bottom of a flush tank having an outlet opening and a valve seat concentric thereto, an annular valve, an upright sectional tubular stem, the sections thereof aligning and being joined by complementary threads, an inverted cup-shaped chamber disposed axially above the valve, the closed top of the chamber having a threaded opening, a cylindrical float mounted on the said section loosely telescoping the chamber and being movable with said section, means to lift said stem to open the valve and space the top end of the float from the top end of the chamber, the said space being normally filled with water and creating a vacuum that retards the descent of the valve during the flushing intervals, and a cup adapted to entrap water during the receding of the main flushing body, said cup having a threaded neck that pierces the top of said chamber, the bore of said neck loosely receiving said section and discharging the water from the cup into said space to prolong the said vacuum.

2. In a flush valve controlling mechanism the combination with the bottom of the flush tank having an outlet and a valve seat concentric thereto, an annular valve, an upright tubular stem to support the valve, a cylindrical chamber disposed axially relatively to the stem, said chamber having a closed top and an open bottom, said top end having a concentric threaded opening, a cylindrical float carried by the stem loosely enclosed by the chamber, means to lift said stem to open the valve, means for spacing the top end of the float from the top end of the chamber, said space when filled with water adapted to create a vacuum to cause the valve to initially descend at slower rate than the level of the flushing body, a normally open cup mounted on the top of the chamber having a threaded neck that screws into the opening of the chamber top, said stem passing through the neck whose bore is larger than the stem to afford passage for water entrapped by the cup to feed into said space to supplement the contents of the space for prolonging the closing of the valve to coincide with the emptying of the tank.

3. In a flush valve controlling mechanism the combination with the bottom of the flush tank having an outlet and a valve seat concentric thereto, of an annular valve, an upright tubular stem to support the valve, a cylindrical chamber disposed axially relatively to the stem, said chamber having a closed top and an open bottom, said top end having a concentric threaded opening, a cylindrical float carried by the stem loosely enclosed by the chamber, means to lift said stem to open the valve, means for spacing the top end of the float from the top end of the chamber, said space when filled with water adapted to create a vacuum to cause the valve to initially descend at a slower rate than the level of the flushing body, the water content of said space being less than the volume required to effect the seating of the valve at a predetermined moment, a normally open cup mounted on the top of the chamber having a threaded neck that screws into the opening of the chamber top, said stem passing through the neck whose bore is larger than the stem to enable water entrapped by the cup to feed into said space to continue said vacuum until said cup and said space are drained.

4. In a flush valve operating mechanism the combination with the bottom of a flush tank having an outlet opening and a valve seat concentric

thereto, an annular valve, an upright sectional tubular stem to support the valve, the sections thereof aligning and being joined by complementary threads, an inverted cup-shaped chamber disposed axially above the valve, the closed top of the chamber having a threaded opening, a cylindrical float mounted on the said section loosely telescoping the chamber and being movable with said section, means to lift said stem to open the valve, means for spacing the top end of the float from the top end of the chamber when the valve is opened, the space between the chamber and float adapted to be flooded with the flushing water by the filling of the tank, and an auxiliary source of water supply comprising a cup having a threaded neck that screws into the opening of the chamber top, said neck being bored to loosely receive said section and afford a passage for the water from the cup to the said space to cause the closing of the valve to coincide with the emptying of the tank, and means to render the valve and its controlling mechanism self-adjusting.

5. In a flush valve operating mechanism the combination with the bottom of a flush tank having an outlet opening and a valve seat concentric thereto, of an annular valve, a sectional stem extending through and supporting the valve, the sections of said stem aligning and being joined by complementary threads, a cylindrical chamber disposed axially above the valve having a closed top formed with an opening through which the lowermost section of the stem reciprocates, a hollow float with closed top movable with said section loosely enclosed by said chamber, means to lift said stem to open the valve, means for spacing the top end of the float when raised from the top end of the chamber, said space adapted to be filled with water to create a vacuum which initially retards the descent of the valve, the water content of said space being less than the volume required to effect the seating of the valve coincident with the emptying of the tank, an auxiliary water cup mounted upon the top of said chamber having a threaded neck that screws into the opening of the chamber top, said section passing through said neck whose bore is larger than the section to enable the water entrapped by said cup to feed into said space to continue said vacuum after the level of the flushing body recedes below the plane of said space.

6. In a flush valve operating mechanism the combination with the bottom of a flush tank having an outlet opening and a valve seat concentric thereto, of an annular valve, a sectional stem extending through and supporting the valve, the sections of said stem aligning and being joined by complementary threads, a cylindrical chamber disposed axially above the valve having a closed top formed with a concentric threaded opening through which the lowermost section of the stem reciprocates, a hollow float mounted concentrically on said section loosely enclosed by said chamber and being movable with said section, means to lift said stem to open the valve, means for spacing the top end of the float when raised from the top end of the chamber, said space adapted when the tank is filled to be flooded with water to create a vacuum which initially retards the descent of the valve, the water content of said space being less than the volume required to effect the seating of the valve coincident with the emptying of the tank, an auxiliary water cup mounted on the top of said chamber having a threaded neck that screws into the opening of the chamber top, said section passing through said neck whose bore is larger than the section to enable water entrapped by said cup to feed into said space to continue said vacuum until the said cup is drained.

7. In combination with a flush tank having an opening for the discharge of water therefrom, a valve for closing said opening, a float for supporting said valve when in its raised position, a casing which is closed at the top and open at the bottom surrounding said float and spaced from the bottom of the tank to permit the passage of water beneath the same to said discharge opening, a tubular overflow member by which said float and valve are carried extending through the top of said casing and means carried by said casing and cooperating with said overflow member to retain said float and valve in their raised positions for a predetermined interval of time after water in said tank has fallen below the top of said casing.

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